FINAL Draft

Updated Proposed Action

for the

FCRPS Biological Opinion Remand

Appendix A: Rationale for Habitat Actions

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Rationale For Habitat Actions

Insofar as habitat variability and complexity are the templates for biodiversity among Pacific salmon and steelhead, one important element to sustaining and restoring populations depends on our ability to conserve and provide suitable habitat complementary to life history variation. Much has been written about the life histories and habitat requirements for successful salmon production (e.g., Groot and Margolis 1991; Bjornn and Reiser 1991). The goal, therefore, is to take this knowledge and prioritize activities that will improve population survival in the near term and long term.

The objective in the near term is to implement actions that will immediately (within one-five years) increase the abundance, distribution, and survival of salmon and steelhead. Such actions may include removing barriers, reducing predation on juveniles, screening irrigation diversions, and improving instream flows where flows limit production of salmon and steelhead. In contrast, the objective in the longer term is to implement actions that protect ecologically "healthy" areas. These areas include important headwaters, diverse riparian areas, biotic refuges, and biological hot spots[1]. Although preservation of existing healthy ecosystems does not translate directly into increased survival, it does protect productive "core" areas from human-caused disturbance. Below we identify and describe high priority near-term and longer-term habitat actions.

Near-Term Habitat Actions

When managing listed stocks, it is important to identify actions that will provide immediate or near-term increases in stock survival. That is, managers should implement habitat actions that have a high probability of increasing stock survival in the short term (within one-five years). The Action Agencies identified the following near-term habitat actions based on actions known to have a high probability of success, low variability among projects (i.e., consistency of results), relatively quick response times, and long duration of results. We cannot give precise survival benefits associated with these actions, because quantitative relationships between tributary habitat actions and salmonid survival are few and localized (Bayley 2002). However, retrospective studies conducted by Marmoreck et al. (2004) indicate that past tributary habitat actions were associated with higher egg-to-parr and parr-to-smolt survival rates in the Snake River; although the relative effectiveness of particular classes of habitat actions could not be assessed.

1. Barrier Removal

Salmon and steelhead require a network of connected spawning and rearing habitats. Migration barriers have fragmented habitats and thus reduced and constrained salmon and steelhead populations and in some cases caused extinction

[1] Biological "hot spots" are generally smaller riverine habitat patches that provide critical biological elements and processes essential to healthy riverine systems (*sensu* Doppelt et al. 1993).

of local breeding populations. For example, Nehlsen et al. (1991) noted that a substantial fraction of 106 stock extinctions might have resulted from migration blockages. In the Yakama River basin, irrigation dams blocked sockeye runs estimated at 200,000 adult fish (Palmisano et al. 1993). At some older irrigation impoundments, fish passage is hindered by poorly designed fish ladders. Smaller diversions may also impede migrations of adult fish or cause juveniles to be diverted into irrigation ditches.

Rearing and spawning habitat of salmon and steelhead has been lost to blockages. In the Columbia basin, about 55% of the total area and 33% of the total stream miles are no longer accessible to salmon and steelhead (Spence et al. 1996). Some of the most productive rearing sites in streams are located in backwaters along the edge of the channel and in side-channel areas (Sedell and Beschta 1991). Highways and railways built next to streams and rivers often disrupt access to these off-channel sites by physically isolating them from the main channel or by including culverts that are impassable for juvenile salmon and trout.

The purpose of barrier removal is to increase connectivity and to open previously unused habitat for salmon and steelhead. Barrier removal includes such things as increasing passage through culverts; removing diversions, dams, and mine tailings; and installing fish ladders. By opening up habitat lost to blockages and increasing passage over or through barriers, survival of salmon and steelhead should increase in the near term.

2. Screening Irrigation Diversions

Unscreened water diversions constitute a significant migration blockage if downstream-migrating juveniles are entrained in diverted water. Nichols (1990) identified over 3,000 unscreened water diversions in Oregon that potentially affect salmon-rearing streams. Juvenile fish can also become impinged on poorly designed screens. In addition to blocking migrations, water withdrawals potentially influence available rearing and spawning habitat. That is, diversions reduce stream flows downstream and ultimately reduce suitable spawning and rearing habitat for salmon and steelhead.

The purpose of this action is to prevent juvenile fish from being diverted into out-of-stream conveyance systems. Proper screens keep fish in the channel and directly reduce mortality. Screening a diversion in the Yakama River resulted in roughly a doubling in the survival of spring Chinook smolts at the canal (Marmorek et al. 2004). Thus, the installation of proper screens at diversions should increase juvenile salmon and steelhead survival in the near term.

3. Leasing or Purchasing Instream Tributary Flows

Salmon and steelhead require suitable stream flows for spawning, rearing, and migration. They are very sensitive to changes in stream flows and time their lifecycle movements according to local discharge regimes (Groot and Margolis 1991). A variety of human activities can alter flows, causing stream flows to become more or less variable than the natural discharge regime, and alter the timing of seasonal runoff patterns. For example, water withdrawals for irrigation, hydroelectric production, urban and industrial consumption, and other uses can shrink stream channels and reduce or eliminate fish spawning and rearing habitat (NRC 1996).

Low flows can dewater redds, limit juvenile habitat, or preclude successful migrations (NRC 1996; Knudsen 2002). Redd dewatering or reduced intragravel flows can lead to egg and alevin desiccation and freezing conditions. Reduced flows can lower stream volume and cause crowding, which might cause increased aggression, competition emigration, and predation on juveniles. Lower flows are often associated with higher water temperatures, leading to increased stress and susceptibility to disease. Finally, low flows can interfere with environmental cues that trigger run timing, upstream migration, and spawning (NRC 1996).

The purpose of this action is to increase stream flows in areas where low flows limit the production and survival of juvenile and adult salmon and steelhead. This will be accomplished by securing additional water through targeted acquisitions of water rights and efficiency transfers. This action will improve both water quality and quantity and should result in near-term survival increases in juvenile and adult salmon and steelhead.

4. Altering Predator Abundance and Distribution

Fish, mammals, and birds are the primary natural predators of salmon and steelhead. Although the behavior of salmon and steelhead precludes any single predator from focusing exclusively on them, predation by certain species can nonetheless be seasonally and locally important. Recent changes in predator and prey populations along with major changes in the environment have reshaped the role of predation (Li et al. 1987).

Northern pikeminnow is the dominant predator of juvenile salmon and steelhead in the Columbia River system, and predation by this species is clearly important compared to other sources of mortality (Poe et al. 1991; Zimmerman 1999). Petersen (1994) estimated the annual loss of juvenile salmonids to predation by northern pikeminnow in John Day Reservoir to be 1.4 million, about 7.3% of all juvenile salmonids entering the reservoir. Of the estimated 200 million juvenile salmonids that emigrate annually through the Columbia River system, about 16.4 million (8%) are consumed by northern pikeminnow (Beamesderfer et al. 1996).

Predation by piscivorous birds on juvenile salmon and steelhead may represent a large source of mortality. Birds have high metabolic rates and require large quantities of food relative to their body size. In the Columbia River estuary, avian predators consumed an estimated 16.7 million smolts (range, 10-28.3 million smolts), or 18% (range, 11-30%) of the smolts reaching the estuary in 1998 (Collis et al. 2000). Caspian terns consumed primarily salmonids (74% of diet mass), followed by double-crested cormorants (21% of diet mass) and gulls (8% of diet mass). The NMFS (2000) identified these species as the most important avian predators in the Columbia River basin.

The purpose of this action is to reduce the abundance of northern pikeminnow and relocate piscivorous birds away from concentrations of salmon and steelhead smolts. These actions should yield near-term survival increases in salmon and steelhead juveniles and smolts. The implementation of the northern pikeminnow reduction program in the lower Columbia and Snake rivers has reduced predation on juveniles by 25% (Friesen and Ward 1999).

Longer-Term Habitat Actions

Perhaps the single most effective habitat-oriented action for salmon and steelhead sustainability is to protect existing good habitat (Frissell 1993; Lichatowich et al. 2000). The concept of protecting remaining ecologically healthy areas is crucial to maintenance and recovery of listed species (NRC 1996; Williams and Williams 1997). Watershed function can be protected through conservation easements and other protective measures that maintain riparian and instream integrity. The Action Agencies identified the following longer-term actions that should increase the survival of salmon and steelhead.

1. Protecting Currently Productive Tributary Riparian Habitat

Riparian zones provide salmon and steelhead streams a connection to and a buffer from upland areas. These zones contribute to salmonid health by providing shade (decreased stream temperatures), streambank stabilization, sediment control, litter input, large woody debris, and nutrients (Spence et al. 1996). Riparian vegetation provides long-term ecosystem function by anchoring streamside soils, providing overhanging and undercut streambanks, increasing habitat complexity, forming pools and braiding, enhancing flows between instream and hyporheic zones, and supplying large woody debris to the stream system (Beschta 1997). Although all of these are essential components of spawning and rearing habitat for salmonids (Bjornn and Reiser 1991), probably the most important component to salmonid habitat is large woody debris. Loss of woody debris from streams usually diminishes habitat quality and reduces carrying capacity for rearing salmon and steelhead during all or part of the year (Hicks et al. 1991).

The purpose of this action is to protect existing productive riparian habitats from human disturbance and development. Land uses such as urbanization, livestock grazing, mining, road building, logging, channelization, agricultural activities, and even recreation can degrade riparian habitat resulting in reduced stream habitat features important to salmon and steelhead, especially rearing juveniles. Protecting these productive areas will ensure the long-term survival of juvenile salmon and steelhead and will also provide “source” areas for recolonizing areas of local population loss (Sedell et al. 1990).

2. Securing Long-Term Protection/Conservation Easements

Agricultural activities have the potential to negatively affect all the important salmon and steelhead habitat components. Cropland agriculture can affect habitat through degradation of water quality by erosion and runoff of sediments, fertilizer, and pesticides (Roth et al. 1996). It can also cause the reduction of habitat complexity, channel stability, and in-channel habitat quality by altering channel and floodplain structure and processes. Agricultural land uses are often associated with hydrologic alteration and contamination of aquifers and groundwater inflows to surface habitats and reduction of substrate quality by increased sediment delivery. Agricultural activities may also increase summer maximum water temperatures.

The purpose of this action is to restore aquatic and riparian habitats by working with agricultural incentive programs. These programs require habitat improvement plans that outline measures for protecting and restoring aquatic and riparian habitats. These measures include such things as fencing riparian areas, establishing minimum riparian buffer lengths, and planting trees and shrubs along stream channels. This action should improve the structure and function of aquatic ecosystems for salmon and steelhead and therefore should increase the survival of juveniles in the long term.

3. Acquiring Productive Mainstem Fish Habitat

Mainstem channels provide a migration corridor for listed salmon and steelhead and rearing habitat for juveniles, especially during winter. Land uses such as hydroelectric development, urbanization and industrialization, diking, streambank armoring and channelization, agricultural activities, and dredging and filling have altered the habitat within mainstem channels. These activities have altered flow patterns, morphology, temperature regimes, sediment regimes, water quality, and the production potential of mainstem rivers (Ebel et al. 1989). As a result, rearing habitat for juveniles has been reduced from historical conditions.

The purpose of this action is to acquire and protect productive habitat within mainstem rivers. Although the biological benefits to salmon and steelhead through habitat acquisition along the mainstem will generally have a smaller effect than similarly scaled efforts in tributaries, the protection of off-channel habitats along the mainstem should translate into long-term survival benefits for juvenile salmon and steelhead.

4. Protecting and Restoring Tidal Wetlands in the Estuary

Naturally complex estuarine habitats are important to juveniles on their way to the ocean (Simenstad et al. 1982). Estuaries are particularly important for salmon for rearing as they make the transition from freshwater to saltwater. In many places, access to intertidal marshes has been eliminated, particularly through diking for agriculture and flood control and for urban port development (NRC 1996). For example, Simenstad et al. (1982) determined that about 90% of estuarine habitat has been eliminated in many developed Puget Sound river deltas. Although 24% of the Columbia River estuary had been converted from wetland habitat type between 1870 and 1983, tidal swamps and marshes together lost some 65% of their former area because of diking and filling (Thomas 1983).

The purpose of this action is to protect and restore tidal wetlands in the estuary. This action calls for breaching levees, developing wetland habitats in sand flats, and creating shallow channels in intertidal areas. In the long term, this action should increase the survival of juveniles and smolts in the estuary.

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